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ABSTRACT

This study was conducted to examine the effectiveness of the UNESCO Primary Science Project being piloted in Grade 5 in selected Malawi schools. Specific objectives included determining: (1) differences in performance and attitudes between students following the UNESCO program and students following the old primary science program and (2) problems being faced by the UNESCO program in the trial schools which were not foreseen by program developers. The major findings indicate the following: there was a significant difference in achievement (in favor of the new program); a greater number of students in trial schools believe they should learn science; little difference exists between schools in student choice of teaching science as a career; about one-third of students in both trial/control schools find science difficult; and several implementation problems (such as large classes, unavailability of resource materials, lack of storage space, low level of understanding when science is taught in English, and others) are faced by the trial schools. These findings (not applicable to all schools because the sample was limited to Lilongwe City schools) suggest that the UNESCO program is bringing about significant improvement in students' science understanding and that the pilot program is helping students develop a more positive attitude toward science than the current science program. Specific recommendations and supporting documentation (in appendices) are included. (JN)

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AN EVALUATION OF THE UNESCO PRIMARY SCIENCE PILOT PROJECT IN MALAWI

1982

ACO Project

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This research project was undertaken as part of a training programme jointly organised on behalf of the African Curriculum Organisation (ACO) by the Kenya Institute of Education (KIE), the University of Nairobi, and the German Agency for Technical Cooperation (GTZ).

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MARIA I. NKAONJA

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by

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Submitted to the Faculty of Education, University of Nairobi, in partial fulfilment of the requirements for the Post-Graduate Diploma in Curriculum Development

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TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS ..... (ii)

TABLE OF CONTENTS ..... (iii)

LIST OF TABLES ..... (vi)

CHAPTER ONE: THE PROBLEMS 1

1.1 Background to the Problem 1

1.2 Objectives of the UNESCO Primary Science Programme 4

1.3 The Primary Education System in Malawi 5

1.4 Purpose of the Study 12

1.5 Significance of the Study 13

1.6 Assumptions of the Study 14

1.7 Limitations of the Study 15

1.8 Definition of Terms 15

CHAPTER TWO: LITERATURE REVIEW 17

2.1 Evaluation of Primary Science Programme in Malawi 17

2.2 Evaluation of Primary Science Programmes in Other Countries 18

CHAPTER THREE: DESIGN OF THE STUDY 24

3.1 Sample 24

3.2 Construction and Administration of Data Collection Instruments 26

3.2.1 Unstructured Interviews 26

		Page
3.2.2	Written Materials	26
3.2.3	Direct Observation	27
3.2.4	Questionnaires	27
3.2.5	Achievement Test	29
CHAPTER FOUR:	ANALYSIS OF DATA	31
4.1	Comparison of Achievement Scores for Trial and Control Pupils	31
4.2	Comparison of Attitudes Towards Science Between the Trial Group and the Control Group	34
4.2.1	Results of Question Two	34
4.2.2	Results of Question Eight	36
4.2.3	Results of Question Nine	37
4.2.4	Results of Question Ten	38
4.3	Some Explanations on the Findings on the Pupils' Attitudes Towards Science	41
4.3.2	Results on the Science Teachers' Appraisal Guide	42
4.3.2	Results of Questions Two and Three from the Teachers' Questionnaire	43
4.3.3	Results of Question Four	44
4.3.4	Results from Question Sixteen	45
4.4	Problems Faced by the UNESCO Primary Science Programme in the Trial Schools	46
4.4.1	Class Size	46
4.4.2	Resource Materials	47
4.4.3	Storage Place.....	48

Page

4.4.4 Pupils' Science Books 48

4.4.5 Pupils' Language Problem 49

4.4.6 Supervision and Feedback 49

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS . 51

5.1 Summary 51

5.2 Major Findings 52

5.3 Conclusions 54

5.4 Recommendations 54

APPENDICES:

A ALLOCATION OF SCIENCE UNITS IN THE PRIMARY SCIENCE CURRICULUM 57

B PRIMARY SCHOOL CURRICULUM AND PERIOD ALLOCATION 58

C A SCIENCE TEACHER APPRAISAL GUIDE 59

D EVALUATION OF THE UNESCO PRIMARY SCIENCE PROJECT - PUPILS QUESTIONNAIRE FOR STANDARD 5 62

E EVALUATION OF THE UNESCO PRIMARY SCIENCE PROJECT - QUESTIONNAIRE FOR SCIENCE TEACHERS TEACHING STANDARD FIVE 65

F A SCIENCE TEST FOR STANDARD FIVE 72

G SPECIFICATION TABLE FOR STANDARD FIVE SCIENCE TEST 75

H RANKED RAW SCORES (IN %) FOR SAMPLE SCHOOLS .. 76

I PUPILS' RESPONSES ON SUBJECT PREFERENCES 77

REFERENCES 79

LIST OF TABLES

TABLE		PAGE
1	Number of Pupils per Class in the Sample Schools in Lilongwe City	9
2	Number of Pupils Selected for the Study from Trial and Non-Trial Schools	25
3	Mean and Standard Deviation Values from Test Results	32
4	Pupils' Evaluation of Science	35
5	Pupils' Responses (In percent) on What They Would do with a Caterpillar which they had Never seen Before	36
6	Pupils' Responses (in percent) on the Subject They Would Like to Teach	38
7	"Yes" and "No" Responses (percent) on Whether Pupils Should Learn Science	39
8	Pupils' Responses on Why Science Should be Taught	40
9	Pupils' Responses on Why Science Should Not be Taught	41
10	Total Teachers' Scores from the Science Teacher Appraisal Guide	42
11	Preference of Science Teaching for Science Teachers	43
12	Teachers' Responses on How They were Trained as Science Teachers	45
13	Pupils' Responses (in percent) on the Subject They Like Best	77
14	Pupils' Responses (in percent) on the Subject They Dislike Most	77
15	Pupils' Responses (in percent) on the Subject They Find Most Difficult	78

CHAPTER ONE

THE PROBLEM

1.1 Background to the Problem

Malawi has, for a long time, realised the need to give its primary school pupils a sound science education. Consequently, science has been taught in the senior primary classes since the 1950's under the title of "Rural Science". In 1961, the Ministry of Education produced a new primary school syllabus under which science was taught as Nature Study in Standards 1-4 and Rural Science in Standards 5-8. In 1966, a new syllabus for primary schools was produced in which Rural Science for Standards 5-8 was replaced by what was called "General Science". Later, attempts were made to make primary science a unified whole so that there should be a continuity between the Nature Study learned in the lower classes and the General Science of the upper classes. These efforts resulted in the production of more coherent primary science units for standards 1-8. The work on science units production was completed in 1971. The units prepared were only in form of teachers' guides. There has been no pupils' science books in the primary schools as yet, but consideration is being given to this task.

It was later realised, however, that the teachers' science units lacked adequate guidance for the teacher and further contained some irrelevant topics as well as some very difficult ones for the classes considered. Thus, it was necessary to

revise both the science materials and the teachers guides. The revision of the primary science for Standards 1-4 was completed by 1974. First revision of Standard 5 Science Units was completed in 1978.

The science units which have been produced have aimed at allowing the pupils to be actively involved in learning about the things around them. They have also been structured to train them in the basic scientific skills, including observation, recording, experimentation and measurements. The units also aimed at providing the pupils with scientific knowledge which can be applied in agriculture, health and hygiene. However, the extent to which these various skills are developed in the actual situation leaves much to be desired in assisting both teachers and pupils. That was why Malawi gladly accepted assistance from UNESCO/UNDP to embark on a new science programme to further improve the science curriculum in its primary schools. Malawi signed an agreement with UNESCO/UNDP in 1977 in which a new primary science curriculum was to be introduced in the primary schools. UNDP was to provide the funds while UNESCO and the Malawi Government would provide the experts for production and implementation of the science curriculum.

The project titled, "Primary Teacher Education and Curriculum Development" commenced with the arrival of the UNESCO experts in early 1980. It was planned that the project should involve both primary teacher education, primary science and mathematics education. The UNESCO specialists who arrived in the country,

therefore, covered several areas: Science, Mathematics, Library Science, Educational Psychology, Media, Educational Technology, Graphics and Reading. To each area, a supernumerary Malawian was attached. The UNESCO experts were to train the Malawian personnel in the various fields as well as in the production of instructional materials. Dr. Govind Sharma was the UNESCO science expert.

The specialists toured the country to assess the condition of education in the primary and primary teachers colleges and later convened the first national science workshop in April 1980. All science tutors from the five primary teachers colleges in the country were invited to participate in the workshop. The main aim of the workshop was to train Malawians in the skills of production of instructional materials for the new programme. Two other workshops were organised at the regional and national levels, respectively. Instructional materials based on the existing science units were developed at these workshops. Materials were developed for Standard 5 as the first experimental class for the UNESCO science programme. The materials included pupils books and teachers guides for the five units which were already being taught in Standard 5. The units covered the following topics: The Flowering Plants, Water, Soil, Air and Balancing.

By the end of 1980, the units had been produced and were circulated to all science tutors, UNESCO experts, Ministry of Education officials and resource persons of the workshops for their evaluation. After some modifications, the Government agreed

to try out the materials in selected primary schools in the country starting in October 1981. In preparation for the piloting of the science materials in the primary schools, a two-week orientation course was conducted in Dedza attended by primary science teachers from the 135 selected pilot primary schools throughout the country.

1.2 Objectives of the UNESCO Primary Science Programme

The content of the UNESCO primary science curriculum for Standard 5, was developed from the science units which had been developed by the Ministry of Education in 1978. Basically, the old and new curricula are similar with only a few differences. The new programme's approach puts greater emphasis on pupil activity. It strives to strike a balance between content and appropriate activities which would permit the pupils to enjoy science learning. Furthermore, the new science programme aims at helping the teacher to actively involve his pupils in meaningful scientific activities in order to facilitate their understanding and thinking, while at the same time maintaining their interest in the subject.

As Sharma (1980), asserts, the new science programme will not only reinforce the pupils' learning but it will also motivate them to learn science by finding out new knowledge in their immediate environment. The new programme also intends to produce science readers in order to assist the pupils with their science learning. In summary, the UNESCO project has the following main objectives directly related to the science education programme as

. . .

outlined in Science Workshop No. 1 (1980):

(i) a substantial upgrading of science implementers at all levels including science tutors at the teachers colleges and primary science teachers in terms of professional competencies and academic qualifications in science;

(ii) an increasing improvement of science curriculum developers and implementers, including the primary science teachers in the process of curriculum renewal so that the teacher training institutions and teachers can be able to design and produce relevant science curriculum learning materials for primary schools and teacher training colleges;

(iii) a steady movement towards the development of performance-based science curricula at both primary school and teacher education levels so that more emphasis is placed on achievement of competencies rather than on content coverage. The project also aims at providing a suitable base for assessment of progress of both the pupils and the programme;

(iv) effective use of science curricula to bring about improvement in learning processes at primary school and teacher education levels.

Objective (iv) is of particular interest to this study as this research aims at investigating the effectiveness of the new primary science curriculum.

1.3 The Primary Education System in Malawi

The type of education system a country has, the quality of its teachers, the size of its classes and the schools' infrastructure all help to determine the success or failure of any new curriculum. It is therefore necessary to briefly discuss some aspects of the primary education system of Malawi.

(a) Objectives

According to The Education Plan of Malawi 1973-1980, there are two basic priority objectives of the primary education, namely: to provide the necessary inputs into the secondary education system; and to provide the educational substructure on which the overall social and economic development of the country must be based. By and large, Malawi's primary education has in the past oriented itself more to the few pupils who proceed on to secondary education than to the majority of the pupils who did not make it to secondary schools. However, of late, the primary education has endeavoured to orient itself more towards the needs of the vast majority of the pupils who terminate their formal education after the primary cycle to make their livelihood in the rural areas. Because Malawi's economy is largely based on agriculture, the Government has planned to achieve qualitative improvement in primary education through curricula consolidation with emphasis upon an agricultural bias. Cummings (1973) states that such a trend will serve to increase both the relevance of primary education to life in the rural sector and also improve the effeciency of primary school education. There is no doubt, that Malawi's primary school leavers would find scientific and technological knowledge, especially in the field of agriculture and health, very useful in their lives in the village. That is one important reason why Malawi has placed great importance on the improvement of its primary science education.

(b) The Primary Cycle

Primary education in Malawi is of eight years' duration and the average entry age is six years. The curriculum includes the following ten subjects: English, ChicheŴa, Arithmetic, Agriculture, Geography, History, Religious Education, Civics, Science and Health Education. Appendix B shows how these subjects are allocated to the different standards and their corresponding periods per week. Appendix A shows the allocation of the science units which make up the primary science curriculum.

There is a national examination which is administered at Standard 5. This examination is used mainly to assess the pupils' progress. The examination is based on three subjects only: Arithmetic, English and ChicheŴa, the national language.

The Primary Cycle concludes with a crucial national examination: The Primary School Leaving Certificate Examination, the results of which are used both for selection for secondary education and for certification. Many pupils pass this examination, but only a very small fraction finds places in the secondary schools. For example, in 1981 55,000 pupils passed this examination but only 5,000 were selected for secondary education representing 9.1 percent of the total number of the candidates who passed the examination.

(c) Primary School Population Increase

The primary school population has been increasing very rapidly over the recent years. For example, the enrolment rose from 481,524 in 1972/73 to 779,676 in 1979/80 academic year

(Ministry of Education 1980), representing a 61.9 percent increase over the eight year period. This rise has been attributed to four main factors:

(i) The presidential appeals to parents to send their children to school.

(ii) Realisation by more parents than before of the importance and need to educate their children.

(iii) An increasing birth-rate which now stands at 3% per annum.

(iv) High rate of repeating, especially at Standard 8, largely due to paucity of places available for the pupils at the secondary school level. Consequently, pupils may repeat three or four times in the hope of being selected to one of the secondary schools.

As a result of this high increase of the school population, primary schools in the whole country are nowadays filled to capacity and beyond (Ministry of Education, 1976). The overcrowding problem is particularly acute in urban schools. Table 1 gives enrolment figures in the six sample schools taken in Lilongwe urban area to illustrate the overcrowding problem in urban schools. Column 2 of Table 1 shows the number of classes in each of the listed schools. For instance, Kawale school has classes for Standards 1-8 each consisting of at least three streams A, B and C. The school altogether has 42 classes for the eight standards. Normally, if classrooms were available, each of the 42 classes should have its own classroom. Column 3 shows that there are only 14 classrooms in the whole school. This means that most of the pupils have to hold their classes

TABLE 1

Number of Pupils Per Class in the Sample Schools In Lilongwe City

School	No. of Classes	No. of Classrooms	Number of Pupils per Standard								Total
			1	2	3	4	5	6	7	8	
Demonstration	16	17	113	109	101	94	89	108	83	107	804
Kawale	42	14	1423	840	387	623	261	291	186	188	4199
Mphungu	19	10	364	238	183	154	127	108	82	110	1366
Chigoneka	30	19	624	450	372	205	205	221	179	326	2582
C.C.A.P.	28	13	574	269	234	227	128	149	159	178	1918
Lingadzi	36	16	730	546	414	272	209	274	188	236	2869

Source: Headmasters' 1981-82 Enrolment Records from Sample Schools

out of doors. The rest of the table is self-explanatory.

(d) School Infrastructure

Most of Malawi's primary schools are generally ill-equipped. In some schools, especially in the rural areas, even the bare necessities such as blackboards and textbooks, are lacking. Up to now, subjects like science have been taught with no pupils books even in the upper primary classes. The only available teaching material has been the teacher's guide. Preparation of teaching aids such as charts by teachers and pupils is limited both by the teachers' lack of initiative and the scarcity of resource materials.

Table 1 reveals the prevalent shortage of classrooms in the primary schools. In five out of the six sample schools in Lilongwe, the number of classes is more than twice the number of classrooms. This shortage of classrooms has necessitated open-air classes in most schools and the double-shift system. This situation is representative of the conditions in many urban schools. Self-help schemes, which have been initiated by the Government, are under way trying to alleviate these problems.

(e) Primary School Teachers

All teachers in Malawi, except those teaching in private schools, are civil servants. The task of training primary school teachers is vested in the five teachers colleges of the country. Three of these colleges, with a capacity of 540 each, are national colleges and they train both T2 and T3 teachers. The other two

smaller grant-aided colleges train T3 teachers only. The difference between these grades lies primarily in the entry qualifications into the colleges. The T2 grade is offered to candidates with the Full Malawi Certificate of Education and T3 to those with the Junior Certificate of Education. Both courses last for two years. In general, the T2 teachers handle the more senior classes while T3 teachers teach in lower classes. There are also T1 teachers who obtain this grade through promotion from the T2 and T3 grades.

Although some T4 and T5 teachers, that is, those with 8 years and 5 years of primary education respectively, still exist in the education system, they are no longer recruited for teaching. They are also being slowly phased out by promotions to the higher grades after they have obtained the necessary academic qualifications through correspondence education.

The teacher training programme in all the colleges does not offer specialised training in any specific subject. Consequently, the teacher trainee receives a general training in how to teach all the subjects which are taught in the primary schools. Thus, there are no specialised teachers to teach science or any other subject. However, all teacher trainees who have gone through Malawi's secondary schools, do have some science background since science, in one form or another, has always been compulsory at the secondary school level.

The recent statistics show that there were 11,558 primary school teachers teaching in the primary schools in 1980. But because of the very rapid increase of the primary school population and an inequittable distribution of the available teachers, there is an acute shortage of teachers in the primary schools. Consequently, this shortage of teachers aggrevated by the shortage of classrooms and instructional materials, makes effective primary school teaching, particularly primary science teaching, a tremendous problem.

1.4 Pupose of the Study

A curriculum programme must be well prepared and constantly evaluated to make it effective. Evaluation of any programme has as its main function to assess and judge the value or worth of the programme. It involves a comparison of what the programme set out to do and what it has actually done or is doing. In a new educational programme like the UNESCO primary science programme, problems arise which may create descrepancies between what has been planned and what is actually achieved within the school system. The problems include:

(a) Lack of clarity of the objectives of the programme.

(b) Lack of proper scope and sequence of the instructional materials.

(c) In_effective teaching approaches.

(d) Lack of teaching competencies.

(e) Lack of teaching resources.

The UNESCO science has been designed to minimise the above mentioned problems in order to make the teaching of science in Malawi's primary schools more effective than it has been in the past. The UNESCO science is presently being tried out in Standard 5. The objective of this study was to assess the impact of the UNESCO primary science approach on Standard 5 pupils, especially in the cognitive and affective domains. At the same time, the study also aimed at bringing to light any problem areas which may not have been foreseen at the inception of the programme. Specifically, the following questions were investigated:

(a) Is there any significant difference between the mean achievement scores, on a given science achievement test for Standard 5 pupils from the schools following the UNESCO primary science programme and those following the old primary science programme?

(b) Is there any significant difference in attitude towards science between Standard 5 pupils from the trial and control schools?

(c) What problems is the UNESCO primary science programme facing in the trial schools?

1.5 Significance of the Study

Every new product must be assessed in terms of what it claims to do before it can gain wide acceptance. Similarly, the UNESCO primary science programme, which is eventually to replace the present one, must be scrutinized and assessed in order to find out its worth. Although the results of this study may not be used to decide whether the new programme has to be fully

implemented or not, the results will nevertheless, provide relevant information on how to improve the programme and hence make it more effective. The results will also help to establish whether the new primary science programme is better or whether it should or should not replace the present science programme.

The study may also bring to light any unanticipated problems of the programme. These can then be rectified before the programme is introduced in all the primary schools. The results of the study can further help the educational system to judge whether this new programme should be implemented as it is or whether it should first undergo some changes before its full scale implementation. Finally, the results of the study may serve as a stepping stone for further research in primary science education in Malawi.

1.6 Assumptions of the Study

The study was done under the following assumptions:

(a) There are adequate funds for the necessary resource materials for the UNESCO primary science programme.

(b) The trial schools received pupils' books and teachers guides in adequate numbers.

(c) All trial schools started the UNESCO science programme in October 1981.

(d) All teachers teaching the UNESCO primary science in Standard 5 had pre-service or in-service courses to orient them to the new programme.

1.7 Limitations of the Study

The three main limitations to this study were finances, personnel and time. Within a period of three months, the time during which this research was carried out, a one-man research team, could do very little. This is why the research sample was limited to one area, Lilongwe City, where the writer is based. Furthermore, only six urban primary schools constituted the sample: three trial schools as the experimental group and three other schools which formed the control group. Financial constraints also restricted the depth and extent to which the study was carried out.

1.8 Definition of Terms

In this study, the following words, phrases, and abbreviations are used as are defined below:

Primary School	: An elementary school covering grades 1 to 8.
Primary Science Programme	: a science curriculum for primary schools.
Science Pilot Project	: a science trial programme; a science curriculum being tried out in a few selected primary schools.
UNESCO Primary Science Programme	: the science programme which is being tried out under UNESCO/UNDP sponsership.
UNESCO	: United Nations Educational Scientific and Cultural Organisation.
UNDP	: United Nations Development Programme.

Trial Schools	:	Pilot Schools; Schools where the UNESCO science is being tried out.
Standard 5	:	Grade 5, that is, the 5th grade of primary education.
Teaching Strategy Rating Scale	:	an instrument used to rate teacher competence and effectiveness.
Achievement Test	:	a test designed to measure a person's knowledges, skills, understanding etc. in a given field taught in school.
T5, T4, T3, T2, T1	:	Primary school teacher qualification grades 5, 4, 3, 2 and 1 respectively. T1 being the highest grade.
APSP	:	African Primary Science Programme.

CHAPTER TWO

LITERATURE REVIEW

2.1 Evaluation of Primary Science Programmes in Malawi

Research on evaluation of primary science programmes has not been undertaken in Malawi. Consequently, there is hardly any literature on this subject. Of the few writings on primary science education in Malawi, the following seem to be related to this study:

Mzumara (1980) reports about R.L. Kimball's 1968 study on the effectiveness of the primary science curriculum. The study compared the ability of school going and non-school going children of the same age to comprehend science concepts. His study revealed that there was no significant difference between the test scores of the two groups. That is, the number of years of science that the pupils had in eight years of school did not influence their test scores significantly. From his findings, Kimball concluded that science teaching in the primary schools had no effect on the performance of pupils and further observed that science in primary schools depended very much on rote memory. Thus, Kimball's findings revealed the ineffectiveness of science teaching in the primary schools at that time.

Sharma (1980), before embarking on the UNESCO primary science project in Malawi, made a survey of science education in the primary schools and in teachers' colleges in the country. He

observed that the following factors hampered the effective use of the present primary science curriculum:

(i) the lack of science learning materials available to primary school children and student teachers;

(ii) lack of knowledge in the process of developing science learning materials on the part of teachers and educators. This factor, according to Sharma, seems to have contributed to the low academic and professional competence of student teachers and primary school teachers in the area of science.

Sharma's second observation that student teachers and primary school teachers generally had low academic and professional competence in science has been substantiated by Shaba's recent findings. Shaba (1981) concluded from his research on the effectiveness of science educators in teachers' colleges in Malawi that science, in all teachers' colleges in the country, was poorly taught.

2.2 Evaluation of Primary Science Programmes in Other Countries

Similar evaluation studies on primary science projects have been carried out in other countries. Sharma (1976) reports on two such evaluations on the Bendel State Primary Science Project which were carried out in Nigeria. The first study was conducted in 1973 and the following were some of his findings:

(a) Childrens' interest in science had been aroused by involving them in meaningful activities. After following the science course, the children observed things around

them more closely and the spirit of discovery and finding facts by themselves became more evident.

(b) Childrens' interest in science was demonstrated by their bringing live animals and feeds to school on their own accord and also by promptly volunteering to collect various types of science materials for classes.

(c) The children also made scientific toys such as telephones, paper wind-propellers, kites, etc.

(d) Science teaching had also helped to remove many native superstitions amongst the children.

In 1975, a research study on the same project was conducted by a team of three evaluators, namely: E.A. Yoloye, S.T. Bajah and W. Falayajo. Some of the findings of the evaluation as recorded by Sharma (1976) are briefly summarised below:

(a) Although the science project plans had been implemented to a large extent, there were delays in the production of materials for some of the grades.

(b) Distribution of the printed books had not been done according to plan. Both pilot and non-pilot schools received books in equal numbers, with the result that the pilot schools, which were supposed to have a book for each child, did not have enough pupils' books.

(c) In general, most of the units developed had been found to be adequate by the teachers and up to the childrens level of ability. The unit on "Our Universe" was the one which presented most difficulties in terms of children's comprehension, the amount of preparation time required by the teacher and the availability of the equipment needed for teaching that unit. On the other hand, the unit "Animal Life" was found to generate the most interest in the children.

Some evaluation studies on the African Primary Science Programme (APSP) have also been conducted by several researchers and some of the results have been recorded by E.A. Yoloye (1978). One such researcher, Duckworth (1971) compared Kenyan children who had been exposed to the APSP with those who had not been exposed. The comparison was in terms of:

(a) the variety of ideas that children had about what to do with unfamiliar materials which they were given;

(b) intellectual ability on six specific tests administered to them.

The results showed that in the first case and in five out of the six tests, the experimental group performed significantly better than the comparison group.

Johnson (1970) investigated the effect of the APSP on teacher-pupil interaction in Sierra-Leone. His experimental groups consisted of six classes which had been exposed to APSP and six other classes which had not been exposed to APSP comprised the control groups. Some of Johnson's results are reported by Yoloye (1978) as follows:

(a) In experimental groups, the incidence of pupils activity was higher than teacher activity whereas the reverse was the case in the control groups.

(b) Teachers in experimental groups used predominantly indirect influence whereas those in control groups used predominatly direct influence.

(c) Pupils in experimental groups exhibited more independent than dependent behaviour whereas those in control groups exhibited more dependent than independent behaviour.

In another evaluation study on APSP, Yoloye (1970) investigated the readability indices of APSP materials and concluded that:

(a) the reading abilities of the average primary school teacher is high enough for them to comprehend the majority of APSP units teachers guides;

(b) the reading abilities of the average primary school child is such that he may have difficulties with the children's background readers.

From the overview of the evaluation work on APSP, Yoloye has come up with some general conclusions of which the most important can be summarised thus:

(a) Although the APSP is generally good, it must be constantly up-dated to keep pace with the changing times and human values.

(b) The success of APSP depends primarily, though not exclusively, on proper training of science teachers.

(c) The success of APSP also depends on the support it receives from the participating governments and the funding agencies.

Finally, Yoloye lists down the three major handicaps which had been met by the APSP evaluation programme as follows:

(i) paucity of appropriate evaluation instruments;

(ii) shortage of qualified manpower in evaluation research; and

(iii) inadequate communication between curriculum workers.

Yoloye therefore suggests that further work on APSP evaluation must find solutions to these problems by intensive research, training of personnel in evaluation research and by improving communication net_works among curriculum workers.

From the citations presented in the preceding discussion, several points can be concluded as follows:

1. A science curriculum based entirely on rote memory can be a very ineffective method for transmitting science concepts to primary school children as evidenced by Kimball's work.

2. Effective primary science teaching can be hampered by low academic and professional competence of primary school teachers in the field of science as has been the case in Malawi according to Sharma's observations and confirmed by Shaba's work. The training of science teachers must, therefore, be given prior consideration if the UNESCO primary science programme in Malawi is to succeed.

3. If a primary science programme is carefully developed and properly implemented, it will both impart scientific knowledge to the children as well as generate their interest in science as has been the case with the Bendel State Primary Science Project in Nigeria.

4. In agreement with Yoloye (1978), the three major factors influencing the success of a science curriculum are:

   (i) continuous renewal of programme;

   (ii) well-trained science teachers; and

   (iii) support from the governments and agencies.

   These factors are likely to influence the success of any science programme such as the UNESCO Primary Science Programme under study much in the same way as in Yoloye's studies.

It is therefore hoped that the investigations in this study will reveal, to some extent, how much these factors have affected the UNESCO Primary Science Project for Standard 5.

CHAPTER THREE

DESIGN OF THE STUDY

3.1 Sample

The study sample was selected as follows:

(a) The schools in Lilongwe City were classified in two groups: one composed of schools which were following the UNESCO Primary Science Programme and the other of schools following the normal primary science programme.

(b) Out of the five trial schools following the UNESCO Primary Science Programme in Lilongwe City, three schools were randomly selected. These formed the experimental group.

(c) Out of the 10 non-trial schools in the City not following the UNESCO programme, three schools were also randomly selected. These formed the control group.

(d) From each selected school, pupils in Standard 5 were used for the study. Since there were more than one Standard 5 classes in each school, one Standard 5 class from each school was selected. The criterion used in choosing the class was that it could be visited during the morning hours in the week.

(e) From each of the six selected classes from the six schools, 20 pupils were randomly drawn. These formed the study material.

The sample schools and the number of pupils involved in the study are shown in Table 2.

TABLE 2

Number of Pupils Selected for the Study From Trial and Non-Trial Schools

Type of School	School	No. of Pupils	Total
Trial	Kawale	20	60
	Lilongwe Demonstration	20	
	Mphungu	20	
Non-Trial	Chigoneka	20	60
	C.C.A.P.	20	
	Lingadzi	20	
Total	6	120	120

The science teachers from the sample schools and the experts who were actively involved in the development of the UNESCO primary science programme, also provided study material for this investigation.

3.2 Construction and Administration of Data Collection Instruments

Several research instruments were employed to assist in the collection of data. These were:

(a) Unstructured interviews.

(b) Written materials.

(c) Direct observation.

(d) Questionnaires.

(e) Achievement test.

After obtaining the necessary letter of introduction from the Chief Inspector of Schools to the local authority of Lilongwe City responsible for the primary schools, the researcher began visiting the schools to collect the data. Each of the research instruments was employed as explained below:

3.2.1 Unstructured Interviews

Unstructured interviews were held by the researcher with some science experts who had been actively involved in the development of the UNESCO primary science programme. These included one primary school inspector, two secondary school science inspectors and Dr. G. Sharma the UNESCO science expert and head of the UNESCO primary science project team.

3.2.2 Written Materials

During visits to the schools, a random sample of pupils' science exercise books from all the schools was examined. This was done as another means of finding out more about the progress

of the science programme. The UNESCO science units as well as the old ones were studied. Reports on the UNESCO science workshops were similarly studied to gain an insight into the objectives of the UNESCO primary science programme.

3.2.3 Direct Observation

All sample schools were visited by the researcher and classroom observations made. An attempt to assess the pupil/teacher interaction was made using a science teacher appraisal guide. This instrument had been adapted from one obtained at Kenya Science Teachers' College, Nairobi.

The instrument uses a five-point rating scale and has 25 pedagogic competencies. The points are classified as follows: 5 = outstanding, 4 = above average, 3 = average, 2 = below average and 1 = weak. During the observations, each teacher was rated from 1 to 5 on each of the 25 competencies. At the end of the class, the scores for each teacher were totalled and a percentage calculated against the total possible score of 125. The mean for the three teachers teaching in the trial schools and that of the three teachers teaching in the non-trial schools were calculated. The data obtained was then used to interpret the data obtained from the pupils.

3.2.4 Questionnaires

Two questionnaires were developed: one for the pupils and the other for their science teachers.

(a) Pupils' Questionnaire

The main aim of the pupils' questionnaire was to obtain information on the pupils' attitude towards science. The questionnaire, shown as Appendix D, had 10 items in three categories: (i) biographical information, (ii) pupils' impressions on the science units which they had learned, and (iii) pupils attitude towards science. These categories were, however, not indicated on the questionnaire to avoid preconditioning the pupils, especially when answering the questions on their attitude towards science.

Before its administration, the questionnaire was tried out for its readability on 60 Standard 5 pupils of M'binzi primary school in Lilongwe City. After the necessary alterations, the questionnaire was finalised and administered to Standard 5 pupils from the six sample schools by the researcher. To avoid disrupting the schools' schedules, the questionnaire was administered during the science period for the class in question and all the pupils of the selected class answered the questionnaire. Later, 20 scripts from the total number of scripts of each class from the six schools, were randomly selected for this study. This gave a total of 120 scripts: 60 from trial schools and 60 from non-trial schools.

The results obtained were then tallied, tabulated and analyzed. The results were presented in tables. The data were then analyzed by the descriptive method.

(b) Teachers' Questionnaire

A teachers' questionnaire, attached as Appendix E was constructed. It had 16 items divided into the following categories: (i) general information, (ii) evaluation of course content, (iii) organisation of the teaching materials, (iv) evaluation of teaching aids, and (v) evaluation of approach. The questionnaire was administered to six teachers who were teaching science in each of the six Standard 5 sample classes from each of the six sample schools.

The results were similarly compiled and analyzed. The smallness of the number of teachers involved was such that no major conclusions could be based on the results of the teachers' questionnaire. The results were, however, found useful in explaining some of the issues in this study.

3.2.5 Achievement Test

A science achievement test, based on the old primary science programme which is in current use, was constructed. The test was considered valid enough for both sample groups because the UNESCO primary science and the old primary science programmes are basically the same in content. Their difference lies in the approach. The test, attached as Appendix F, consisted of 25 items from three

domains of knowledge, broadly divided into (i) Knowledge of facts, (ii) Application, and (iii) Evaluation. The specification table indicated in Appendix G, shows the domains to which each of the items belonged.

After the test items had been constructed, they were moderated by a group of four people consisting of two primary school teachers, a science inspector and the researcher. As in the case of the pupils' questionnaire, the test was then tried on 60 Standard 5 pupils of M'binzi primary school mainly for its readability. After corrections and revisions had been made, the test was administered to all pupils of the selected Standard 5 class in each of the sample schools. Scripts of the 120 pupils, from six sample schools, whose questionnaires had been analyzed were marked and their ranked percentage scores are shown in Appendix H.

Finally, the means and the standard deviations for the two groups were calculated. The t-test was then used to test whether or not the difference in the mean performance between the trial and non-trial schools was statistically significant at the 95 percent level of significance.

CHAPTER FOUR

ANALYSIS OF DATA

4.0 This study was conducted in order to determine the effectiveness of the UNESCO primary science programme on Standard 5 pupils in Lilongwe City schools in terms of the following three points:

(a) whether there is any significant difference in performance between pupils following the UNESCO primary science programme and the pupils following the old primary science programme;

(b) whether there is any appreciable difference in attitude towards science between pupils studying the UNESCO primary science programme and those studying the old primary science;

(c) whether there are any problems being faced by the UNESCO primary science programme in the trial schools, which were not foreseen by the programme developers.

This chapter will present analyses of the data collected on these issues.

4.1 Comparison of Achievement Scores for Trial and Control Pupils

As stated in Chapter 3, a science test based on the specification table indicated in Appendix G was administered to the sample schools. The test had 25 items. The mean and the standard deviation values calculated from the test results are shown in Table 3. The student's t-test was used to determine whether or not the difference between the mean values of the two groups was statistically significant at the 95 percent confidence level. The null-hypothesis advanced was that there was no difference in performances

TABLE 3

Mean and Standard Deviation Values from Test Results

Pupils	No. of Pupils (N)	Mean ($\bar{X}$)	Standard Deviation(s)
Trial	60	51.5	18.1
Control	60	35.2	15.0

between pupils taught by either method. The mean performance of the two groups were therefore expected to be equal. The alternate or test hypothesis was that the mean performances of the two groups were different and expected the trial group mean to be far superior to the control group mean. Thus the null hypothesis, H_o, and the alternate hypothesis, H_1, can be expressed as follows:

$$H_o : \bar{X}_1 = \bar{X}_2$$

$$H_1 : \bar{X}_1 = \bar{X}_2 \text{ or, in any case, } \bar{X}_1 \neq \bar{X}_2$$

where X_1 and X_2 are trial and control group means respectively.

The formula used for the t-test was the following:

$$t = \frac{X_1 - X_2}{\sigma d} \qquad (1)$$

where σd is the pooled standard deviation appropriate to the difference between the two group means from the sampled population. This value was estimated from the weighted average of the sample variances, S_1^2 and S_2^2, with equal sample sizes, $N_1 = N_2 = 60$, by the following equations:

$$\sigma_p^2 = \frac{(N_1 - 1)\, S_1^2 + (N - 1)\, S_2^2}{2\,(N - 1)} \qquad (2)$$

and

$$\sigma_d = \sqrt{\frac{2\,\sigma_p^2}{N}} \qquad (3)$$

where σ_p^2 is the weighted average of the sample variances, S_1^2 and S_2^2 for the trial and control groups, $N = N_1 = N_2 = 60$ and $2\,(N - 1)$ is the test degrees of freedom.

The data obtained from the two pupil groups are presented in Appendix H, together with their associated means and variances. Formula (2) was applied to the data to calculate σ_p^2 as follows:

$$\sigma_p^2 = [59\,(327.6) + 59\,(225)]/118$$

$$\sigma_p^2 = 276.3$$

Hence, by substitution in formula (3)

$$\sigma_d = \sqrt{2\,\left(\frac{276.3}{60}\right)}$$

$$\sigma_d = 3.03$$

The students' t-value was then obtained by formula (1) thus:

$$t = (51.5 - 35.2/3.03$$

$$t = 5.37$$

The tabulated t-value with 118 degrees of freedom at the 5 percent probability level is about 1.99 (Steel and Torrie, 1960, Table A.3 p.433).

Since the calculated t-value (5.37) exceeds by far the tabulated t-value, the difference in mean values between the trial and control school groups is declared to be highly significant at

the 95 percent confidence level. It is therefore concluded that the UNESCO science programme is bringing about a significant improvement in the pupils level of understanding of the science subject compared with the current programme.

4.2 Comparison of Attitudes Towards Science Between The Trial Group and The Control Group

Four items on the pupils' questionnaire, questions 2, 8, 9 and 10 were used to assess the attitudes of pupils towards science. The results and their discussions follow.

4.2.1 Results of Question Two

In this question, pupils were asked to choose from a list of subjects the one they

a) liked best;

b) disliked most;

c) found most difficult.

Rather than focus on science only, five other subjects namely, English (Eng.), Arithmetic (Arith.), Art, Chichewa (Chich.) and History (Hist.) were included to remove pupils' bias towards science and for the researcher's interest. Results of the full range of courses is given in Appendix I. Those on the science subject are given in Table 4 for the subsequent discussions.

From Table 4, 11.7 percent of the pupils in the trial schools like science best. The results shown in Appendix I also indicate that in the trial schools, science is the second best-liked subject among the six subjects. On the otherhand, science

ties with art for the last place with only 1.7 percent of the pupils in the control schools, choosing it as the subject they like best (see Appendix I). Only 8.3 percent of the pupils in the trial schools dislike science most compared with 20 percent of the pupils in the control schools.

TABLE 4

Pupils' Evaluation of Science

Pupils' Evaluation	SCHOOLS*	
	Trial (%)	Control (%)
Like Best	11.7	1.7
Dislike Most	8.3	20.0
Find Most Difficult	31.7	33.3
Uncertain	48.3	45.0
Total	100	100

*N = 60 for both schools.

Although 31.7 percent of the pupils in the trial schools and 33.3 percent of the pupils in the control schools definitely find science most difficult, the greatest majority in both schools is undecided about it. However, from the mean performances in this subject discussed earlier, it is apparent that the undecided pupils in the trial schools perform well in the subject compared with those in the control schools.

From these results, one can infer that a greater number of pupils in the trial schools like science and have developed a more positive attitude towards it than the pupils in the control schools. It can, therefore, be concluded that the UNESCO programme is helping pupils to develop a more positive attitude towards science than the current programme.

4.2.2 Results of Question Eight

In question 8, pupils were asked to say what they would do if they found a strange caterpillar on their way from school. The options given were:

a) I would kill it.

b) I would take it home and keep it to see what will happen to it.

c) I would tell my friends about it.

d) I would throw it away.

Table 5 shows the results obtained.

TABLE 5

Pupils' Responses (In Percent) on What They Would Do with a Caterpillar which they had Never Seen Before

Pupil	N	OPTIONS				Total
		a	b	c	d	
Trial	60	8.3	51.7	28.3	11.7	100
Control	60	11.7	30.0	50.0	8.3	100

Table 5 shows that 51.7 percent of the pupils from the trial schools, compared with 30 percent from the control schools, chose (b), indicating a difference of almost 22 percent between the two groups.

In the researcher's view, the most significant option to aid in assessing the pupils' interest in science is option (b) as it demonstrates a sense of curiosity and interest in an individual. Consequently, a larger numbe· of pupils choosing option (b) would indicate a more positive attitude towards science among the pupils.

It is, therefore, concluded that pupils from the trial schools have a more positive attitude towards science than those in the control schools.

4.2.3 Results of Question Nine

Question 9 asked the pupils to choose, from a list of subjects, one which they would like to teach if they became teachers. The subjects were:

Agriculture (Agr.)	English (Eng.)
Arithmetic (Arith.)	Geography (Geog.)
Art	History (Hist.)
Chicheŵa (Chich.)	Science (Sci.)

Table 6 shows the results obtained.

The results show that 5 percent of the pupils from the trial group would like to teach science compared to 3.3 percent in the

control group. The difference between the two groups is, however, too little to permit any firm conclusions to be made about the pupils' attitudes towards science. It may only be fair to conclude that regardless of the science programme exposed to the primary schools, the number of future science teachers cannot be easily predicted.

TABLE 6

Pupils' Responses (in percent) on the Subject They Would Like to Teach

Pupils	N	S U B J E C T S								Total
		Agr.	Arith.	Art	Chich.	Eng.	Geog.	Hist.	Sci.	
Trial	60	6.6	11.7	3.3	1.7	60.0	1.7	10.0	5.0	100
Control	60	5.0	15.0	5.0	1.7	53.4	8.3	8.3	3.3	100

4.2.4 Results of Question Ten

Question 10 asked the pupils whether or not they should learn science. They were to answer Yes or No and then give reasons of their own for their answer. Table 7 gives the results of the first part of the question.

The following reasons were given by those pupils who gave "Yes" for an answer:

a) Science is useful to my life.

b) Science is interesting.

c) Science is a good subject.

d) Science has experiments.

e) Science teaches us many things around us.

f) Science will help me go to Standard 8.

g) No reason given.

The "No" response had the following reasons:

a) Science is too difficult.

b) I dislike science.

c) We dirty our hands when doing experiments.

d) No reason given.

TABLE 7

"Yes" and "No" Responses (percent) on Whether Pupils Should Learn Science

Pupils	N	OPTIONS			Total
		YES	NO	NO RESPONSE	
Trial	60	95.0	5.0	-	100
Control	60	78.3	13.3	8.3	100

Tables 8 and 9 which are derived from Table 7 shows the reasons given by the pupils as to why science should or should not be taught.

The results in Table 7 indicate that 5 percent of the pupils from the trial schools felt that they should not learn science. In the control schools, 13.3 percent felt the same way and another 8.3 percent was totally undecided. Thus, a total of 21.6 percent of pupils in the control schools either dislike or are indefferent

to science. In Table 8, 36.2 percent of the pupils in the control schools who felt that science must be taught, gave no reason as to why they should learn science. This observation is quite significant in that it seems to suggest that there is little or no interest in science among a greater number of pupils in the control schools.

From the results of Tables 7 and 8, it can be concluded that the pupils from the trial schools have a more positive attitude towards science than the pupils from the control schools.

However, Table 9 indicates that 87.5 percent of the pupils in the control schools who felt that science should not be taught found the subject to be too difficult. This suggests that the lack of interest in science among the pupils in the control group can be attributed to the fact that they find science too difficult rather than the pupils' natural dislike of the subject. This may also have a significant bearing on how the subject is presented to them.

TABLE 8

Pupils Response on Why Science Should be Taught

Pupils	No. of 'Yes'	REASONS (%)							Total
		a	b	c	d	e	f	g	
Trial	57	19.3	22.8	17.5	21.1	19.3	-	-	100
Control	47	25.6	17.0	17.0	-	-	4.2	36.2	100

TABLE 9

Pupils' Response on Why Science Should Not be Taught

Pupils	No. of 'No'	REASONS (%)				Total
		a	b	c	d	
Trial	3	33.3	-	33.3	33.3	≃ 100
Control	8	87.5	12.5	-	-	100

4.3 Some Explanations on the Findings on the Pupils' Attitudes Towards Science

Teachers' attitudes towards science as well as their competency in science teaching is likely to affect pupils' attitudes towards science. If science is taught in such a way as to capture the pupils' interest, the pupils tend to respond enthusiastically to what they learn and their power to comprehend what they have learnt tends to increase. On the other hand, if a science lesson is boring, the pupils will tend to take a disliking to science. On these premises it was necessary to observe classroom interaction between pupils and teachers and to assess the science teachers' attitudes towards science in order to explain objectively the results obtained from the pupils' responses.

Below are the results from the science teachers' appraisal guide and from questions 2, 3, 4 and 10 of the teachers questionnaire.

4.3.1 Results on the Science Teachers' Appraisal Guide

As already explained in Chapter 3, an observation instrument, attached as Appendix C, was used to assess the effectiveness of the six Standard 5 science teachers in the sample schools. The instrument has 25 items with a total possible score of 125 points. Table 10 shows the results obtained.

TABLE 10

Total Teachers' Scores from the Science Teacher Appraisal Guide

Teacher	No. of Teachers (N)	SCORES (%)			Mean
		N_1	N_2	N_3	
Trial	3	77.4	75.8	81.6	78.3
Control	3	65.8	72.5	65.2	67.8

Results from Table 10 show that teachers in the trial schools performed better in the teaching of science than those from the control schools in terms of the observed mean scores. These results though based on subjective judgement, are valid enough to explain why the pupils in the trial schools exhibit a more positive attitude towards and perform better in science than those in the control schools.

4.3.2 Results of Questions Two and Three From the Teachers' Questionnaire

Question 2 asked teachers to give a list of subjects in the order they would prefer to teach them. The subjects were: English, History, Science, ChicheŴa and Arithmetic. Table 11 shows the results in reference to science.

TABLE 11

Preferences of Science Teaching For Science Teachers

Teachers	No. of Teachers (N)	Science as 1st Choice (%)	Science Not as 1st Choice (%)	Total
Trial	3	33	67	100
Control	3	67	33	100

Question 3 asked the teachers who did not put science as their first choice to teach to give a reason for their answer. The options were:

a) I don't like science.

b) I find science teaching too demanding.

c) I was not trained to teach science.

d) Other (please, state).

The results showed that 100% of the teachers in each group gave (b) as the reason, that is, science teaching is too demanding for them.

The results of question 3 may also help to explain the results of question 2 in that the science teachers in the trial schools received extra training in the teaching of science through in-service training. Hence, they follow the activity method more closely than the lecture method. Consequently, these teachers have become so conscientious in their class preparations and executions of the class activities that they inevitably spend a lot of time in these preparations. Hence, they would rather teach other subjects which are less demanding than science. On the other hand, the science teachers from the control schools who depend on the little knowledge in science teaching still left in them since their college days may not even realize how demanding science preparations ought to be.

4.3.3 Results of Question Four

This question asked the teachers how they were trained as science teachers. The options were:

a) Pre-service and in-service training.

b) Pre-service training only.

c) In-service training only.

d) No training at all.

The results in Table 12 explain the higher performance by teachers in the trial schools than that by teachers in the control schools. It is obvious, therefore, that the better quality training of science teachers in the trial schools must have contributed to the more positive attitude towards science

in the trial than in the control schools.

TABLE 12

Teachers' Responses on How They Were Trained as Science Teachers

Teachers	No. of Teachers (N)	OPTIONS (%)				Total
		a	b	c	d	
Trial	3	100	-	-	-	100
Control	3	-	67	-	33	100

4.3.4 Results From Question Sixteen

Question 16 asked the teachers who were familiar with both science programmes to indicate whether the approach of the UNESCO science programme to science was different from that of the current programme and, if so, how? The criteria used to indicate the differences for the UNESCO approach were:

a) has more pupil activity;

b) is better organised;

c) gives better explanation to the pupils;

d) offers more help to the teachers;

e) offers science reading materials to pupils;

f) is not different from the current approach.

Results showed that all the three teachers from the trial schools were familiar with both science programmes and ascertained that

the UNESCO science approach is different from the current approach. They were all in agreement also that the UNESCO approach has the characteristics a, b, c and d above. One teacher also added (e) to the list of characteristics.

From these results, it is inferred that the teachers in the sample trial schools find the UNESCO primary science programme much better than the old primary science programme. It is possible, therefore, that the satisfaction which the teachers derive from the UNESCO science programme permits them to teach enthusiastically and thus generate interest in the subject among the pupils. Under these conditions, it is easy to envisage a more positive pupil/teacher interaction which may explain the general positive attitude towards science among the trial schools.

4.4 Problems Faced by the UNESCO Primary Science Programme in the Trial Schools

One of the objectives of this study was to investigate into any unforeseen problems which are being faced by the UNESCO primary science programme in the trial schools. To this end, interviews were held with various people as already mentioned in Chapter 3. Observations were also made during the class visits, and a teachers' questionnaire was employed. Data were then collected and analysed as discussed below.

4.4.1 Class Sizes

The classes were generally large, ranging from 50 to 115 pupils in one normal-sized classroom. Such big classes were found to be very difficult to handle and control especially during experimental work.

More and better classes are urgently needed at all schools to improve the quality of education in the Lilongwe City primary schools.

4.4.2 Resource Materials

Resource materials were found to be lacking in most schools, but the trial schools were found to be generally better at improvisation. For instance, some teachers were found using cut tops of plastic bottles as filter funnels, or soft plastic bags as balloons. However, certain materials such as salt and sugar could not be improvised and therefore the schools had problems in getting such items. Teachers had to rely on pupils to bring such materials from home.

Question 13, on the teachers' questionnaire, asked about the availability of teaching aids. Two of the teachers from the trial schools said that few were available whereas the third teacher said that many were available. From the researcher's own observations, one trial school, Lilongwe Demonstration, was found to be better equipped in science materials than the rest of the schools.

On investigation, it was intimated that UNDP funds were granted to the Ministry of Education and Culture for the purpose of supplying the trial schools with all the materials needed for the programme. However, there were still some unresolved problems between the Ministry Headquarters and the local education authorities on how the funds should be distributed to the schools and how the schools should account for the funds spent.

These problems ought to be resolved fast as, indeed, the final evaluation of the project will be affected by such administrative problems.

4.4.3 Storage Place

Most of the schools were found to lack safe storage places for collected items. Although nature tables are recommended in trial schools on which to keep and display pupils' work, it was found out that most of the schools had hardly anything on their nature tables.

The teachers explained that the materials on display were usually destroyed or stollen by other pupils since the classrooms were also used by other classes due to paucity of classrooms. In addition, any materials which could be re-used could not be kept safely because there were no lockable cupboards in most schools, to store them.

Apart from special science classrooms, it is essential that such provisions as lockable cupboards, drawers, etc. should be made available to promote effective science teaching in the primary schools in Lilongwe City.

4.4.4 Pupils' Science Books

Pupils in all trial schools were supposed to have a pupils' science book each during the programme. However, only one school, Lilongwe Demonstration, had a pupils' science book for each pupil in the class. The second school, Kawale, only managed to get one copy between two pupils in April, 1982 through the researcher's efforts. The third school, Mphungu, had only the teacher's copy for the whole class!

The significance of this problem is clearly demonstrated by the achievement test which showed the performance of the trial schools in the following descending order: Lilongwe Demonstration, Kawale and Mphungu. It is therefore, concluded that pupils' science books are essential tools in enhancing the pupils' learning ability of and interest in the subject.

4.4.5 Pupils' Language Problem

In discussions with the head of the UNESCO Primary Science Programme team, it was learnt that the programme's developers were aware of the pupils' limitations in english, which is the language of instruction. Efforts were, therefore, made to write the pupils books in simple eng lish as much as possible. However, it was observed that the pupils' language problem does not only arise in reading and understanding the pupils' book. It has also been noticed in the pupils' ability to follow and understand a science lesson taught in english. In all the cases observed, the teachers had to literally translate the science lesson lesson in the national language, Chicheŵa, whenever possible. It was not unusual in certain cases to see teachers get themselves in a fix trying to find suitable equivalent Chicheŵa translations of some basic scientific words such as "function", "characteristics", etc. This problem partly explains why the test results from both groups were generally from average to low.

4.4.6 Supervision and Feedback

Supervision of the UNESCO primary science programme is supposed to be done by the District Inspector of Schools (DIS) whose job is to inspect all schools in his district at regular intervals. Feedback

from the project schools is supposed to be provided by the science teachers concerned, in the form of regular progress reports sent to the Ministry Headquarters through the District Inspector of Schools.

The researcher's investigations reveal that the supervision and feedback system has not been as effective as it should have been. The reporting is so far behind that ongoing evaluation of the programme has hardly been done by programme developers.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This study was conducted to examine the effectiveness of the UNESCO Primary Science Project which is being tried out in selected trial schools in Malawi. Due to time and financial limitations, only schools in the Lilongwe ity were considered in this research which was conducted between May and August, 1982.

The study had three specific objectives which aimed at finding out the following:

(a) whether there is any significant difference in performance between pupils following the UNESCO primary science programme and pupils following the old primary science programme;

(b) whether there is any appreciable difference in attitude towards science between pupils studying the UNESCO primary science and the old science;

(c) whether there are any problems being faced by the UNESCO primary science programme in the trial schools, which were not foreseen by the programme developers.

The study sample consisted of two groups of Standard 5 pupils from Lilongwe City primary schools. The first group, the experimental group, consisted of 60 pupils, randomly selected from three trial schools which were also randomly selected among the five trial schools in Lilongwe City which are following the UNESCO primary science. The second group, the control,

also had 60 pupils randomly selected from three schools where the old primary science is being taught. The three schools were randomly selected from a total of ten schools.

Teachers teaching science in Standard 5, headmasters of the sample schools, and some of the people who were directly involved in developing the UNESCO primary science programme were also included in the study.

The study used the following research instruments for data collection:

(a) Unstructured interviews.

(b) Direct observations.

(c) Written materials.

(d) Pupils' questionnaire.

(e) Teachers' questionnaire.

(f) Pupils' achievement test.

Data were collected and analysed. The student's t-test was used to determine whether the difference in mean values between the two groups on the achievement test was statistically significant at the 95 percent confidence level.

5.2 Major Findings

A. The difference in mean values between the trial and control school groups was found to be highly significant at the 95 percent level of confidence. The calculated t-value, with 118 degrees of freedom was 5.37 compared with the tabulated t-value of 1.99.

B. A greater number of pupils in the trial schools than those in the control schools believe that they should learn science.

C. There is little difference between pupils in trial and control schools in their choice to teach science when they complete school.

D. About a third of pupils in both trial and control schools find science difficult.

E. The UNESCO primary science programme is facing some problems in the trial schools, which were not taken into account by the programme developers. The most notable ones are listed below:

(i) The classes are generally too large and this makes it very difficult to teach science effectively.

(ii) Science resource materials had not been provided to the trial schools at all as planned by the programme even though UNDP funds had been made available for this purpose.

(iii) Trial schools had lack of safe storage space for the materials they collected or produced.

(iv) Pupils' science books which were to be given to each pupil in the trial schools at the beginning of the project were not made available except to only one trial school in the sample.

(v) Pupils have a low level of understanding a science lesson taught in English. As a result, teachers are obliged to literally translate science lessons into Chichewa. This fact slows down science teaching and makes it more difficult.

(vi) Supervision and feedback of the UNESCO primary science programme in the trial schools has not been as effective as it should have been. As a result, there has hardly been any formal evaluation compiled yet by the programme developers.

5.3 Conclusions

From the findings of this study the following major conclusions can be made:

(a) The UNESCO primary science programme is bringing about a significant improvement in the pupils' level of understanding of the science subject compared with the current science programme.

(b) The UNESCO primary science programme is helping pupils to develop a more positive attitude towards science than the current science programme.

It must be mentioned, however, that since the study had a limited sample and was only done in Lilongwe City schools, these conclusions cannot be widely applicable to all other schools in the country. Further investigations on a wider scale are necessary to confirm these conclusions.

(c) The UNESCO primary science programme developers should look into the problems which have been revealed by this study and find solutions, so that the UNESCO primary science programme can be more effective.

5.4 Recommendations

In view of the findings of this study, the following recommendations are made:

(a) Primary science teachers should be given adequate background in science and science teaching through pre-service and in-service training.

(b) An adequate number of teachers in primary schools should be invited to the UNESCO primary science in-service training so that there is more than one qualified science teacher at each school, prepared to teach the UNESCO science programme.

(c) More classrooms should be constructed so that each class size should be about 45-50 pupils in order to make science teaching more effective.

(d) The Ministry of Education and Culture should make sure that the UNESCO primary trial schools receive the available UNDP funds in good time so that the necessary resource materials are bought and distributed to schools by the beginning of the next academic year. The resource materials should include a pupils book for each child in the trial schools.

(e) The local education authority for the City of Lilongwe should provide the primary schools with some permanent storage places where science equipment can be stored safely. The storage room could be in the form of lockable cupboards or drawers in the classroom or storeroom.

(f) Pupils must be helped by both parents and teachers to raise their level of understanding the English language so that by the time they are in Standard 5, the pupils should be able to follow an average science lesson.

(g) A better system of supervision of the UNESCO science programme should be established. A special district primary science inspector (DPSI) could be appointed for each district. This arrangement would be similar to the present one in Home Economics where a special District Needlework Organiser (DNO) is appointed for each district. Such an officer would have his own job description and would work hand in hand with the UNESCO Science Organisers as well as the science inspectors at the Ministry Headquarters. Transport should also be provided to the DPSI by the district education authorities.

(h) The UNESCO primary science programme should be introduced in all the primary schools in the country after its trial period is over.

APPENDIX A

ALLOCATION OF SCIENCE UNITS IN THE
PRIMARY SCIENCE CURRICULUM

STANDARD 1

Living things
Seeds and plants
Water
Air around us
Keeping our bodies healthy
Stones around us

STANDARD 2

Light and shadows
Growing some plants
Earthworms and Caterpillars
Flowers
Leaves
Sand and Clay

STANDARD 3

Looking at some materials
Growing plants without seeds
The world around us
Insects
Fruits and seeds
Measuring

STANDARD 4

Animal study
Water
Weather
Trees near the school
Learning from cooking

STANDARD 5

The flowering plant
Soil
Water
Air
Balancing

STANDARD 6

Living things and their
Surroundings
Animal study
Weather
Heat

STANDARD 7

Light
Non Flowering plants
Animal study
Sound
Temporary and permanent change

STANDARD 8

Introduction to Astronomy
Liquids
Electricity
Moulds and Bacteria
Human Body
Measurements

APPENDIX B

PRIMARY SCHOOL CURRICULUM AND PERIOD ALLOCATION

The following is the recommended curriculum and period allocation for primary schools:

Standards	S1	S2	S3	S4	S5	S6	S7	S8
Length of period (minutes)	30	30	35	35	35	35	35	35
	Number of periods per week							
Religious Education	3	3	3	3	3	3	3	3
Chicheŵa	10	8	8	8	8	4	4	4
English	5	7	9	9	9	9	9	9
Arithmetic	5	5	5	5	5	6	6	6
History and Civics	2	2	3	3	3	3	3	3
Geography	2	2	2	2	2	2	2	2
Agriculture	-	-	-	-	-	4	4	4
Science	2	2	2	2	2	4	4	4
Housecraft and Needlework (G) or Handicraft (B)	-	-	2	2	2	4	4	4
Art and Craft	2	2	1	1	1	1	1	1
Physical Education	2	2	2	2	2	2	2	2
Health Education	2	2	2	2	2	2	2	2
Music	2	2	1	1	1	1	1	1

APPENDIX C

A SCIENCE TEACHER APPRAISAL GUIDE

Date_____

Class_____

School_____

Mark each quality of a five point scale as follows: 1 = weak, 2 = below average, 3 = average, 4 = above average, 5 = Outstanding. Put a tick (_/) under the appropriate column.

QUALITY	SCORE				
	1	2	3	4	5
1. Aims: Are the aims of the lesson clear and appropriate to the level of the class?					
2. Content: Has the content been selected to match the aims, level of the class and the teaching method?					
3. Organisation of the Lesson: Has the teacher a clear idea of the structure of the lesson as evidenced by the lesson notes or the lesson performance?					
4. Preparation of Experimental work and Teaching Aids: Has the teacher organized the necessary apparatus and materials before the lesson?					
5. Beginning of the Lesson: Do all the pupils come quickly to attention and direct themselves to the tasks to be accomplished and are the lesson aims made clear by the teacher?					
6. Clarity of Presantation: Does the teacher have a good grasp of the lesson content and is the content presented so that it is understandable to the pupils?					
7. Use of Teaching Aids: Are all opportunities taken for the use of appropriate teaching aids?					

QUALITY	SCORE				
	1	2	3	4	5
8. Blackboard Work: Is the teacher's blackboard work clearly arranged and legible?					
9. Use of Experimental Work: Are all opportunities taken for the inclusion of experimental work appropriate to the level of the class and the content of the lesson?					
10. Is the experimental work well integrated into the lesson and does it lead to a useful conclusion?					
11. Is the teacher aware of any hazards associated with the experimental work and does he/she take all the necessary safety precaution?					
12. Does the teacher ensure that all pupils are aware of what is happening in the experiment?					
13. Questioning Technique: Are the questions framed clearly and do they test both knowledge and understanding of the pupils?					
14. Are the questions well distributed throughout the class?					
15. Does the teacher deal effectively with both right and wrong answers?					
16. Does the teacher, through good questioning techniques, obtain from the pupils the main conclusions that can be drawn from the experimental work?					
17. Pupil Activity: Are all pupils involved in a range of activities in different learning situations throughout the lesson?					
18. Pacing of the Lesson: Does the teacher stay with the class and adjust the tempo accordingly?					
19. Pupil Level of Interest: Are all pupils attentive and interested throughout the lesson?					

QUALITY	SCORE				
	1	2	3	4	5
20. Evaluation: Does the teacher use an adequate variety of procedures to evaluate the progress of the class?					
21. Ending the Lesson: Does the teacher attempt to review the main facts and ideas dealt with in the lesson?					
22. Teacher enthusiasm and Drive: Is the teacher enthusiastic about the work and is he/she able to transmit this enthusiasm to the class?					
23. Speech: Is the teacher's voice audible and the speech clear and varied in tone?					
24. Class Control: Does the teacher have good class control?					
25. Teacher-Pupil Rapport: Does the teacher have friendly and harmonious relationship with the class?					

APPENDIX D

EVALUATION OF THE UNESCO PRIMARY SCIENCE PROJECT
PUPILS QUESTIONNAIRE FOR STANDARD FIVE (5)

Please, answer all the questions on this questionnaire in the spaces provided.

1. Name_____ School_____
   Sex_____ District_____
   Standard_____ Date_____

2. The following are some of the subjects you learn at this school:

Arithmetic	English
Art	History
Chicheŵa	Science

   Among these subjects, pick one subject which you

   a) like best_____
   b) dislike most_____
   c) find most difficult_____

3. Below is a list of science units which you have to study. Put a tick (_/) in the box next to each unit which you have learned already.

   Use a tick (_/) too when answering questions 5, 7 and 8.

   a) The Flowering plants ☐
   b) Soil ☐
   c) Water ☐
   d) Air ☐
   e) Balancing ☐

4. The unit I liked best is_____

5. This is because this unit

   a) is helpful to my life. ☐
   b) has a lot of experiments. ☐
   c) is easy to understand. ☐
   d) allows us to go out more often to learn about the things around us. ☐

6. The unit I disliked most is _____

7. This is because this unit

   a) is very dull. ☐
   b) has very few experiments. ☐
   c) is very difficult to understand. ☐
   d) is too long ☐

8. If you found a caterpillar which you had never seen before, on your way to school, what would you do with it?

   a) I would kill it ☐
   b) I would take it home and keep it to see what will happen to it. ☐
   c) I would tell my friends about it. ☐
   d) I would throw it away. ☐

9. If you were to become a teacher after you finish school, which subject would you like to teach? Choose <u>one</u> below.

_____

Agriculture	English
Arithmetic	Geography
Art	History
Chicheŵa	Science

10. Do you think that you should learn science?

a) YES ☐ because _____

_____

b) NO ☐ because _____

_____

APPENDIX E

EVALUATION OF THE UNESCO PRIMARY SCIENCE PROJECT
QUESTIONNAIRE FOR SCIENCE TEACHERS TEACHING STANDARD FIVE

Please, answer all the questions on this questionnaire. The information will help the Ministry of Education and Culture to improve science education in Malawi. Your co-operation is very much appreciated.

Please, respond by either ticking (_/) the box against the appropriate answer or by filling in the blank spaces with appropriate answers.

1. GENERAL INFORMATION

1. Name of School_____ District_____
   Date_____

2. Column A, in the table below, has a list of five subjects which are taught to pupils in your school. In Column B, arrange these subjects in the order of your teaching preference, putting your first choice at the top.

Column A	Column B
Subjects	Order of teaching preference
English	
History	
Science	
Chichewa	
Arithmetic	

3. If science is not your first choice, what is the reason?

a) I don't like science. ☐

b) I find science very difficult. ☐

c) science teaching is too demanding. ☐

d) I was not trained to teach science. ☐

e) other (please, state)_____ ☐

_____

4. How were you trained as a science teacher?

a) through pre-service and in-service training. ☐

b) through pre-service training only. ☐

c) through in-service training only. ☐

d) no training at all. ☐

II. EVALUATION OF COARSE CONTENT

5. How interesting have your pupils found the science unit you have taught?

Unit	Very Interesting	Interesting	Un-interesting
The Flowering Plants			
Soil			
Water			
Air			
Balancing			

6. How difficult have your pupils generally found the different science units which you have taught?

Unit	Very Difficult	Difficult	Average	Easy
The Flowering Plants				
Soil				
Water				
Air				
Balancing				

7. How difficult do you find to teach the different units?

Unit	Very Difficult	Difficult	Average	Easy
The Flowering Plants				
Soil				
Water				
Air				
Balancing				

8. How do you judge the amount of the content for each unit?

Unit	Too Much	Right amount	Too little
The Flowering Plants			
Soil			
Water			
Air			
Balancing			

9. How do you rate the level of english used in the pupils book? (To be answered by UNESCO Science Project teachers only.)

Unit	Very Difficult	Appropriate	Easy
The Flowering Plants			
Soil			
Water			
Air			
Balancing			

III. ORGANISATION OF THE TEACHING MATERIALS

10. Taking each unit as a whole, how would you rate the organisation of the topics of each unit?

Unit	Very Satisfactory	Satisfactory	Un-satisfactory
The Flowering Plants			
Soil			
Water			
Air			
Balancing			

11. Teacher Activities

What would be your overall rating of the suggested teacher activities for each unit?

Unit	Very Satisfactory	Satisfactory	Un-satisfactory
The Flowering Plants			
Soil			
Water			
Air			
Balancing			

12. Pupil Activities

How would you rate the suggested pupil activities for each unit?

Unit	Very Satisfactory	Satisfactory	Un-satisfactory
The Flowering Plants			
Soil			
Water			
Air			
Balancing			

IV. EVALUATION OF TEACHING AIDS

13. To what extent are the teaching aids suggested in the units available in your school?

a) All of them are available. ☐

b) Many are available. ☐

c) A few are available. ☐

d) None is available. ☐

14. When the teaching aids are not available, what do you normally do?

a) I omit the activity. ☐

b) I report to the Headmaster who then assists in making the teaching aids available. ☐

c) I make them myself when I can. ☐

d) I ask the pupils to make them if this is possible. ☐

15. How appropriate are the suggested teaching aids for the different units?

Unit	Very Appropriate	Appropriate	In-appropriate
The Flowering Plants			
Soil			
Water			
Air			
Balancing			

V. EVALUATION OF APPROACH

16. How different is the approach used in the UNESCO Primary Science Project schools from the old approach used in the rest of the schools? (To be answered by those teachers who have used both science approaches.)

The UNESCO approach

a) has more pupil activity. ☐

b) is better organised. ☐

c) gives better explanation to the pupils. ☐

d) offers more help to the teachers. ☐

e) offers science reading materials to the pupils. ☐

f) is not different from the old approach. ☐

For No. 16, you may tick (_/) more than one box.

THANK YOU FOR YOUR CO-OPERATION.

APPENDIX F

A SCIENCE TEST FOR STANDARD FIVE

Name_____ School_____

Sex_____ Date_____

ANSWER ALL QUESTIONS IN THE SPACES PROVIDED.

1. Give one work of stems in plants._____
2. Give one work of petals in a flower._____ _____
3. Give one work of roots in plants._____
4. Will roots which are covered with oil be able to take in water?_____ _____
5. How are flowers which have a sweet smell pollinated?_____
6. How are flowers which are not brightly coloured pollinated?_
7. What can happen if a flower has no anthers?_____
8. What can happen if a flower has no ovules?_____
9. What can happen if a plant does not have green leaves?____
10. What can happen if a plant has yellow leaves only?_____

Diagram 1 shows two fruits, chisoso and mchewere. Look at them carefully and then answer questions 11 and 12.

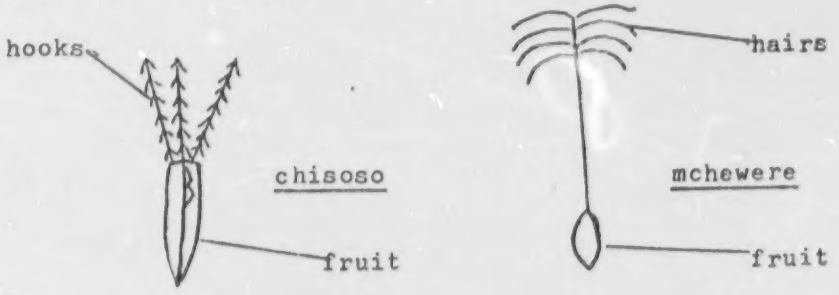

Diagram 1

11. How will chisoso be carried away?_____
12. How will mchewere be carried away?_____
13. Name one living thing in the soil which makes things to rot?
14. When dead things rot in the soil, what do they become?_____

In questions 16 to 20, match correctly List A with List B. Number 15 has been done for you as an example.

LIST A		LIST B
15. Insect pollinated flowers.	D	A. Clay soil.
16. Sugar	___	B. loam soil.
17. Good soil for making pots.	___	C. sandy soil.
18. Soil which will dry out fastest.	___	D. produce nectar.
19. Sprite.	___	E. an example of a solution.
20. Good soil for farming.	___	F. an example of a solute.
		G. an example of an insoluble substance.

21. What will happen if a rock is strongly heated and then dropped in cold water?

Diagram 2 shows a kettle of boiling water. Look at it carefully and then answer questions 22 and 23.

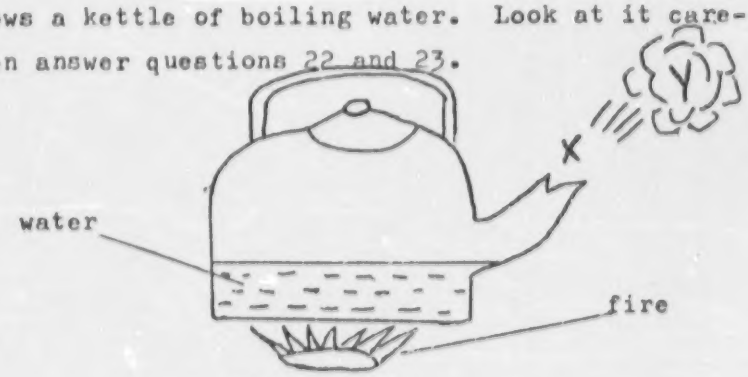

Diagram 2

22. What is formed at X which cannot be seen?_____
23. What is happening at Y?_____
24. Which is colder, liquid water or ice?_____
25. Is heat necessary to change ice into liquid water?_____

Look at diagram 3 carefully and then answer question 26.

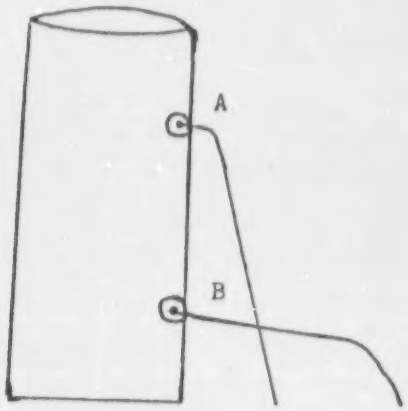

Diagram 3

26. From which hole is water coming out with more strength?__

APPENDIX G

SPECIFICATION TABLE

FOR STANDARD FIVE SCIENCE TEST

BEHAVIOURS / CONTENT	RECALL OF FACTS	COMPREHENSION/ APPLICATION	ANALYSIS/ EVALUATION	TOTAL
Flowering Plants	5	4	3	12
Soil	3	2	1	6
Water	3	2	2	7
TOTAL	11	8	6	25

APPENDIX H

RANKED RAW SCORES (IN %) FOR SAMPLE SCHOOLS

TRIAL SCHOOLS		CONTROL SCHOOLS	
88	52	72	36
84	52	64	36
80	48	56	36
80	48	56	36
80	44	56	36
76	44	52	36
76	44	52	32
76	40	52	32
72	40	48	32
72	40	48	32
68	40	48	32
68	40	44	32
68	40	44	28
68	40	44	28
68	40	44	28
68	36	44	28
64	36	44	28
64	36	44	28
60	36	40	28
60	32	40	24
60	32	40	24
60	32	40	24
60	28	40	20
60	28	36	20
56	28	36	20
56	28	36	20
56	24	36	16
52	20	36	16
52	20	36	12
52	16	36	12

$\bar{X}$ = 51.5 SD = 18.1

$\bar{X}$ = 35.2 SD = 15.0

APPENDIX I

PUPILS' RESPONSES ON SUBJECT PREFERENCES

TABLE 13

Pupils' Responses (in percent) on The Subject They Like Best

Pupils	N	S U B J E C T S						Total
		Eng.	Sci.	Arith.	Chich.	Hist.	Art	
Trial	60	60.0	11.7	10.0	10.0	8.3	0.0	100
Control	60	61.7	1.7	20.0	8.3	6.6	1.7	100

TABLE 14

Pupils' Responses (in percent) on The Subject They Dislike Most

Pupils	N	S U B J E C T S						Total
		Eng.	Sci.	Arith.	Chich.	Hist.	Art	
Trial	60	8.3	8.3	21.7	8.3	31.7	21.7	100
Control	60	3.3	20.0	6.7	6.7	28.3	35.0	100

TABLE 15

Pupils' Responses (in percent) on The Subject They Find Most Difficult

Pupils	N	S U B J E C T S						Total
		Eng.	Sci.	Arith.	Chich.	Hist.	Art	
Trial	60	3.3	31.7	41.7	5.0	15.0	3.3	100
Control	60	5.0	33.3	31.7	10.0	8.3	11.7	100

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